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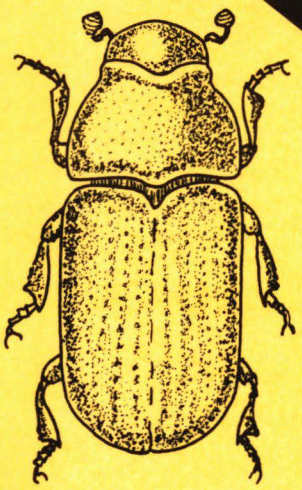
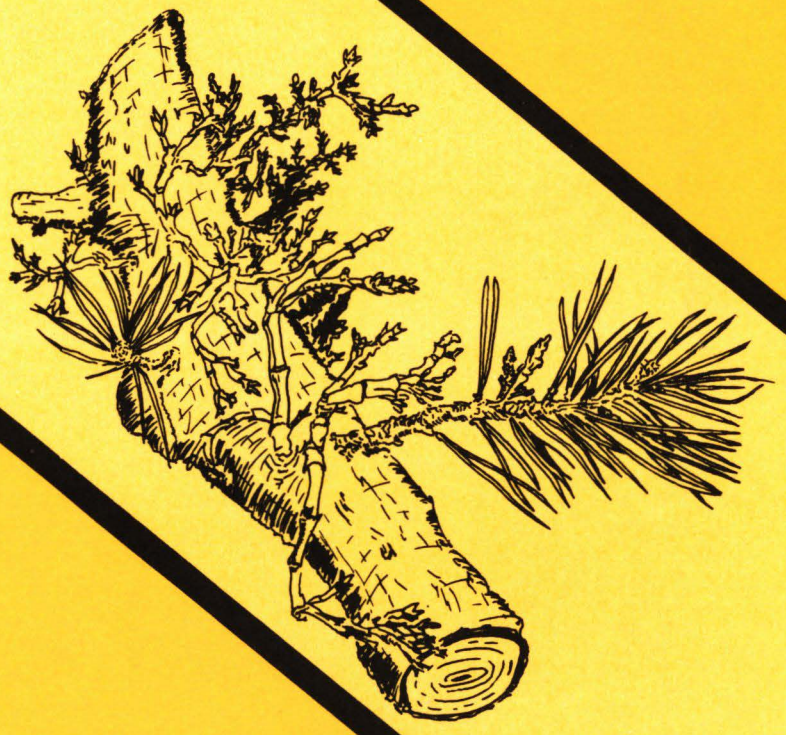
BIOLOGICAL EVALUATION
Western Spruce Budworm

Carson National Forest
New Mexico

1980





Southwestern Region

U. S. DEPARTMENT OF AGRICULTURE

FOREST SERVICE

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BIOLOGICAL EVALUATION
Western Spruce Budworm

Carson National Forest
New Mexico

1980

Forest Pest Management
State and Private Forestry
Southwestern Region, USDA, Forest Service
517 Gold Avenue, S.W.
Albuquerque, New Mexico 87102

PREPARED BY:

IRAL R. RAGENOVICH, Entomologist
Forest Pest Management

APPROVED BY:

DOUGLAS L. PARKER
Director of Forest Pest Management

THOMAS G. SCHMECKPEPER
Deputy Regional Forester

ABSTRACT

The western spruce budworm, Choristoneura occidentalis Free., outbreak continued to increase and mixed conifer stands were defoliated on both divisions of the Carson National Forest and the Taos Pueblo Indian Reservation. A total of 108,450 acres was defoliated in 1980.

Average egg mass densities on the Questa and Taos entomological units increased substantially over those recorded in 1979, and stands defoliated in 1980 will sustain heavier defoliation in 1981. Heaviest defoliation will continue to occur along Red River and Cabresto Creek on the Questa unit, and along the Rio Fernando de Taos and around Palo Flechado Pass on the Taos unit. New areas showing an increase in defoliation will include the El Rito and Tres Piedras Ranger Districts.

The western spruce budworm outbreak is expected to continue for several more years on the Carson National Forest and adjacent lands of mixed ownership.

Pest management alternatives and recommendations are discussed in this evaluation report.

INTRODUCTION

The western spruce budworm, Choristoneura occidentalis Free., continued to defoliate mixed conifer stands on the Carson National Forest and adjacent lands. Visible defoliation [1/] was first reported on the Taos and Questa entomological units in 1975 and 1976, respectively. Defoliation was also recorded on the El Rito and Tres Piedras Ranger Districts (Tres Piedras entomological unit). Total acres defoliated on the Forest and adjoining lands from 1976 to 1980 were 21,760, 40,200, 15,039, 30,542, and 108,450, respectively.

Egg mass surveys were conducted on the Taos, Questa, and Tres Piedras entomological units and the results are summarized in this evaluation. Management alternatives and recommendations are also presented.

TECHNICAL INFORMATION

Insect.--Western spruce budworm, Choristoneura occidentalis Freeman

Host.--Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco
White fir, Abies concolor (Gord. and Glend.) Lindl.
Subalpine fir, Abies lasiocarpa (Hook.) Nutt.
Blue spruce, Picea pungens Engelm.
Engelmann spruce, Picea engelmannii Parry.

Life History.--The western spruce budworm completes one generation each year (Furniss and Carolin 1977).

Stage	Time	Location on Host
Egg	August	On needles
Small larvae	Overwinter	In hibernaculum (silken cocoons) on branches and trunk
Large larvae	June	On buds and strobile
Pupae	July	On foliage
Adults	August	In flight

Evidence of Infestation

1. Young larvae feeding on newly expanding buds and strobile.
2. Mature larvae consuming current year's needles.
3. Shoots webbed together by larvae.
4. Webbed shoots turning brown and falling from trees.
5. Defoliation most evident in upper crowns of trees.
6. Trees dying from top downward after several years of heavy defoliation.

1/ Visible defoliation based on the aerial detection survey.

Extent of Defoliation in 1980.--Defoliation was visible from the air on 108,450 acres of the Carson National Forest and adjacent lands. Severity of defoliation was categorized as: light, 54,925 acres; medium, 43,200 acres; and heavy, 10,325 acres. Defoliation on separate ownerships is as follows:

	L	M	H
Carson National Forest	24,600	32,400	7,550
Taos Pueblo Indian Reservation	17,675	7,650	50
Other Lands	12,650	3,150	2,725

This represents a significant increase in the number of acres in each defoliation class reported in 1979.

Defoliation increased in area and intensity Forest-wide. Noticeable areas of increase were north of the Rio Fernando de Taos and along the east side of the Taos entomological unit, and along the south sides of Red River and Cabresto Creek. Several small areas of light defoliation were also recorded on the Tres Piedras Ranger District near Hopewell Lake, Broke Off Mountain, and Placita Spring. Light and moderate defoliation was recorded on the El Rito Ranger District west of El Rito Creek and between Canada Sierra and Canada Piedra.

Figures 1-4, in the Appendix, show the extent and intensities of defoliation that occurred on the Taos, Questa, Tres Piedras, and El Rito Ranger Districts, respectively.

BIOLOGICAL INFORMATION

Relative Abundance of Pest

Methods.--Egg mass surveys were conducted in August to provide an indication of larval densities and corresponding defoliation expected to occur in 1981. Samples were taken from 42 plots in the Questa, Taos, and Tres Piedras entomological units. Two branches (70 cm in length) were cut from opposite sides of the midcrown of three sample trees on each plot. Sample trees met the following criteria: Douglas-fir, dominant or codominant; 30-50 feet in height; relatively open grown with a full crown; and some budworm feeding evident, but the tree could not be severely defoliated or top-killed. Each branch was individually bagged in 1/4-bushel cloth bags, tied, labeled, and transported to a laboratory for examination. All sacks were stored in a walk-in cooler at about 40° F.

In the laboratory, the foliage was examined under ultraviolet light for budworm egg masses. Needles bearing egg masses were classed as from current year's foliage, or a previous year's foliage, and kept separate in labeled pill boxes. Egg masses were separated

as new or old by an experienced laboratory technician. All egg masses on current year's foliage were classed as new, and their characteristics formed the basis for aging egg masses found on previous year's foliage.

Defoliation predictions for 1981 were determined from the density of 1980 egg masses using the following information presented by McKnight et al. (1970):

Egg mass density [a/]	Predicted defoliation class [b/]
<1.55	Undetectable for all infestations
1.71 to 6.20	Undetectable for "static" infestations Light for "increasing" infestations
9.30 to 31	Light for "static" infestations Moderate for "increasing" infestations
>34.10	Moderate for "static" infestations Heavy for "increasing" infestations

a/ Number of egg masses per square meter of foliage.
b/ Defoliation class limits (percent of new growth).
Undetectable = 5 percent
Light = 5 to 35 percent
Moderate = 35 to 65 percent
Heavy = 65 percent

Results.--Results of the egg mass and aerial detection survey are presented separately for each entomological unit.

Taos Entomological Unit. This entomological unit includes the Carson National Forest and Taos Pueblo Indian Reservation. Egg mass survey data on the unit indicate that budworm populations will remain at relatively high levels in this unit in 1981. The average egg mass density was 50.6 egg masses per meter square of foliage and ranged from 16.35 near Angel Fire, in the southwestern most edge of the infestation, to 90.1 egg masses near Capulin. Heaviest egg mass densities and defoliation extend along either side of the Rio Fernando de Taos from Cruz and Ranchos Canyons east to Palo Flechado Pass, and north and south of the Pass.

Table 1 shows a summary of the egg mass and defoliation on the Taos entomological unit.

Questa Entomological Unit. An average egg mass density of 47.6 egg masses per meter square of foliage indicate that insect densities in 1981 will continue at high levels on this unit. Heaviest egg mass densities and defoliation occurred south of the Red River from Goat Hill Campground east to Red River Ski Area, and along the south side of Cabresto Creek from Eagle Rock east to Bonito Canyon.

Table 1: Summary of the egg mass and aerial detection surveys on the Taos and Questa entomological units.

Taos Entomological Unit		1976	1977	1978	1979	1980
New egg masses/sq. m foliage		38.3	22.3	36.3	42.8	50.6
Buildup ratio [a/]		1.7:1	0.6:1	1.6:1	1.2:1	1.2:1
Actual defoliation [b/] (acres)	L	9,400	15,040	2,725	6,477	31,200
	M	6,600	10,800	2,790	9,191	26,750
	H	560	0	4,250	282	6,975
Questa Entomological Unit						
New egg masses/sq. m foliage			9.9	17.9	43.1	47.6
Buildup ratio [a/]			3.4:1	1.7:1	2.4:1	1.1:1
Actual defoliation [b/] (acres)	L	1,900	13,080	2,560	3,174	22,850
	M	300	960	2,330	5,197	15,550
	H	0	320	384	6,221	3,275

a/ Buildup ratio is the ratio of new egg masses in the survey year to new egg masses of the previous year.
b/ Actual defoliation as determined from aerial detection survey. L = light, M = moderate, H = heavy.

Table 1 shows a summary of the egg mass and defoliation on the Questa entomological unit.

Tres Piedras Entomological Unit. This unit includes both the Tres Piedras and El Rito Ranger Districts. Separate areas of infestation were recorded for the first time in each District in 1980.

There were 550 acres of light defoliation detected on the Tres Piedras Ranger District. Egg mass samples showed an average of 1.8 egg masses per square meter of foliage.

Defoliation on the El Rito Ranger District was: light, 325 acres; moderate, 900 acres; and heavy, 75 acres. Egg mass samples averaged 29.7 egg masses per meter square of foliage in the infested area.

Discussion and Prediction of Trend

The western spruce budworm outbreak on the Taos and Questa entomological units is expected to continue at moderate to heavy levels in 1981. Defoliation is also expected to increase in area and in intensity on both units. With the expansion of the infestation along the east side from Palo Flechado Pass north to Taos Peak, the Questa and Taos entomological units have essentially become one contiguous infestation and can no longer be considered as separate infestations. Barring any natural factor(s) that could bring about the collapse of the outbreak, it is expected to continue for several more years. Heaviest defoliation and subsequent tree damages and losses should continue to occur along the Rio Fernando de Taos, Palo Flechado Pass, Red River, and Cabresto Creek in the Questa and Taos entomological units. Heavier defoliation should be evident along the Rio Puerco de Taos on the Taos unit and in Hondo Canyon on the Questa Unit.

Areas of light and moderate defoliation will expand on the Tres Piedras and El Rito Ranger Districts.

MANAGEMENT ALTERNATIVES

Maintain Present Management.--With this approach, the outbreak would be allowed to run its course until a population collapse occurred from a combination of: a) a lack of foliage to maintain a larval population; b) unfavorable weather conditions; c) heavy predation and parasitism; and d) a microbial epizootic. Adverse and beneficial effects of the outbreak would have to be accepted. These are:

1. This alternative would not be effective in preventing additional tree damages. Impacts to resource values and uses caused by the budworm would have to be accepted under this alternative. Although damages resulting from the western spruce budworm in the

Southwest are currently unknown, maximum damages similar to those estimated for the Pacific Northwest could occur if the outbreak continues unabated. These include the following:

Tree damages	Maximum damages (percent)
Growth loss	30
Understory mortality	25
Sawtimber mortality	5
Top-killing	25
Cone crop reduction	90+
Christmas tree use reduction	90+

2. There would be no direct costs associated with selection of this alternative although timber values will be affected and revenues reduced when severely damaged stands are harvested. Also, the depletion of the understory could necessitate the expenditure of funds for reforestation.

3. Visual qualities and economic and social impacts would result if this alternative was selected.

Silvicultural Management.--Silvicultural treatments in mixed conifer stands should be designed to create stand conditions that reduce tree damages. For example, prescriptions should: a) open up stands by logging, thinning, and burning; b) maintain stand densities favoring ponderosa pine and aspen; c) favor prescribed burning to reduce the percentage of firs and Engelmann spruce; d) regenerate stands by artificial means using ponderosa pine stock; e) favor even-aged stands; and f) salvage damaged and insect-killed trees.

Effects of this alternative are:

1. The trend of the current outbreak would not be changed if a silvicultural program was initiated. Tree damages would be the same as those listed under the "Maintain Present Management" alternative.

2. Conversion of mixed conifer stands to a less susceptible state would be very costly; however, long-term benefits could be achieved.

3. Visual qualities and economic and social impacts would result if this alternative were selected.

Direct Suppression.--Aerial application of a pesticide registered by the Environmental Protection Agency (EPA) could be done to suppress all or part of the outbreak on the Forest. However, if only part of the infestation is treated or if adjoining lands are not treated, one or

two additional treatments may be required during the infestation cycle since treated stands could be reinfested from nearby areas that were not treated.

Application would be carefully timed to the development of the larvae, i.e., when 20 percent of the larvae are in the fifth and sixth instars. This would insure maximum effectiveness with a minimum dosage of insecticide. An application of this type is designed to utilize indigenous natural control agents to further reduce and maintain the budworm population at a low level.

Effects of this alternative are:

1. If a direct suppression program were to be carried out on the Forest in 1981, additional tree damages and losses could be minimized in the areas treated by reducing insect densities.

2. Although there would be immediate costs associated with application of a pesticide, positive benefits could possibly be achieved by preventing additional adverse affects to timber and recreation values.

3. Environmental effects would be minimal and temporary, and visual quality would be enhanced.

Insecticides registered for use against the budworm follow:

1. Carbaryl (carbamate insecticide)

The Sevin ® oil formulation of carbaryl has given consistently satisfactory results in suppressing budworm outbreaks throughout the West. An outbreak on the Santa Fe National Forest, New Mexico, was successfully suppressed in 1977, and the outbreak has remained at a low level for 4 2/ years (Parker and Ragenovich 1980). Carbaryl is a non-persistent pesticide which is available for general use. One (1) pound of active ingredient per acre is the registered dosage rate, and no lasting environmental effects have been identified at this application rate.

2. Orthene ® (organophosphate insecticide)

Orthene ® is a non-persistent insecticide registered for use against the western spruce budworm and other forest defoliators. Although this insecticide has been shown to be effective against the budworm, it has never been used in the Southwest.

3. Malathion (organophosphate insecticide)

Malathion is a non-persistent, broad spectrum insecticide, registered for use against more than 100 insects, including the west-

2/ 1980 field data unpublished.

ern spruce budworm. However, it is not recommended because it has yielded inconsistent results in suppressing outbreaks.

4. Microbial Insecticides

Microbial insecticides, such as Bacillus thuringiensis (B.t.), a bacterium, and viruses need further research testing and field evaluation before they are ready for use. In June 1980, several B.t. formulations were tested by the Pacific Northwest Forest and Range Experiment Station in conjunction with CANUSA [3/]. The results of this testing are still being evaluated, but tentative analyses indicate that adequate suppression was not achieved.

Treatment of High Value Trees.--In recreation areas, VIS Centers, and other areas where defoliation of high value trees would be unacceptable, individual or small groups of budworm-infested trees could be treated by a ground application of an EPA-registered insecticide to reduce the larval density and prevent the adverse effects of defoliation.

Effects of this alternative are:

1. Because only selected high value trees within an infestation could be treated, this would require a number of applications during the outbreak cycle since treated trees would be reinfested from the nearby infestation.

2. Application costs associated with this alternative would have to be accepted.

3. Adverse environmental effects would be minimal and temporary.

RECOMMENDATIONS

Management of the Current Western Spruce Budworm Outbreak

1. Short-term Pest Management.--Based on the age, extent, and intensity of the western spruce budworm infestation on the Taos and Questa entomological units, the recommended management alternative is to maintain present management.

Land management objectives for some areas within the infested area, such as high value areas, may justify partial treatment. Such areas within the infestation would need to be examined on an individual basis to determine the best management alternative.

3/ The Canada/U.S. Spruce Budworms Program (CANUSA--West) is a 6-year research and development program that is funded through 1983.

Infestations on the Tres Piedras and El Rito Ranger Districts are new outbreaks and could be treated by direct suppression to prevent further damages.

2. Long-term Pest Management.--Long-term silvicultural management for western spruce budworm can be accomplished by including pest management considerations into timber and fire management programs. For example, management programs should facilitate the removal of susceptible old growth and favor ponderosa pine, Douglas-fir, and aspen in vigorous mixed conifer stands.

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APPENDIX

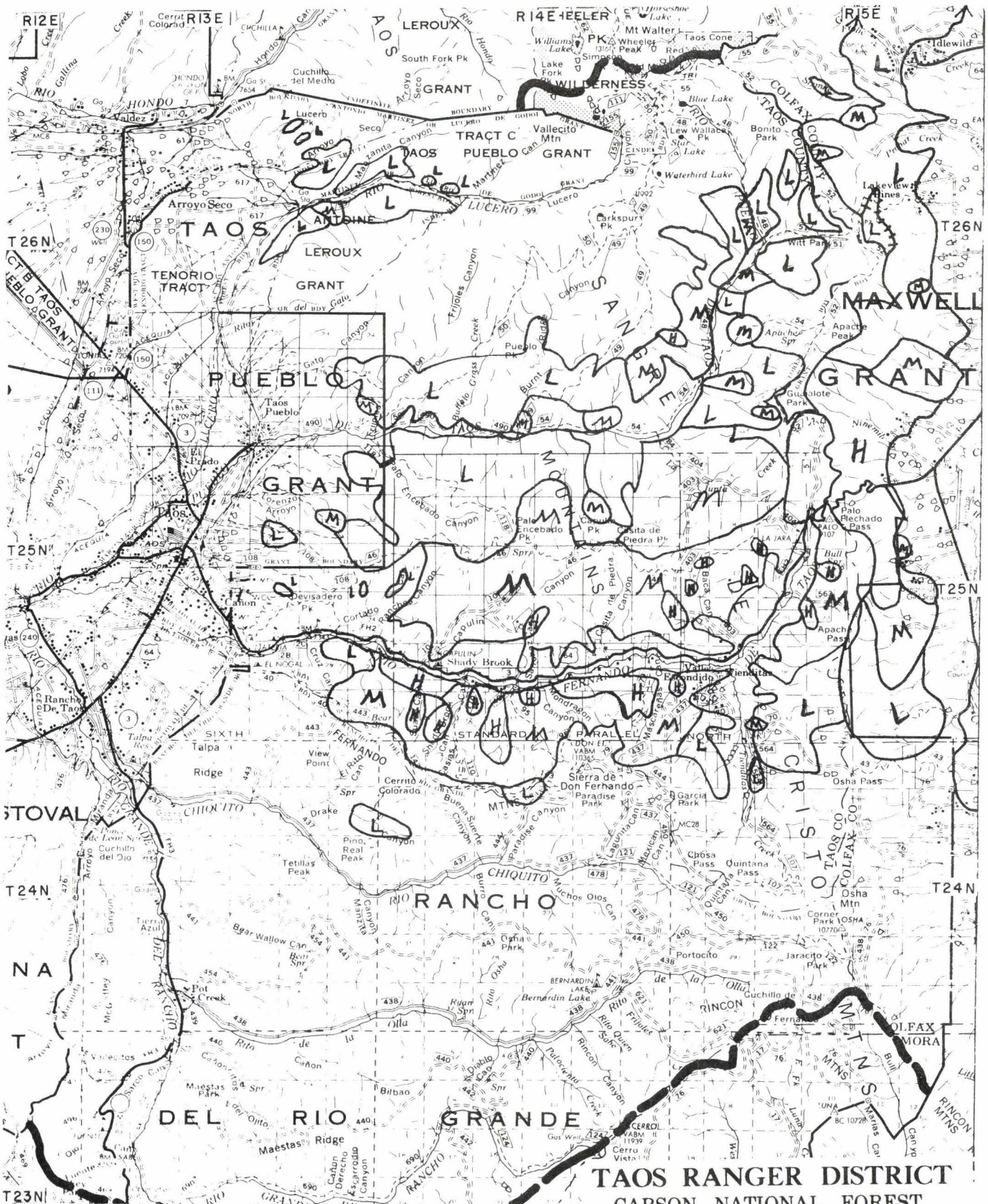


Figure 1.--Extent and intensity of western spruce budworm defoliation on the Taos entomological unit, 1980.

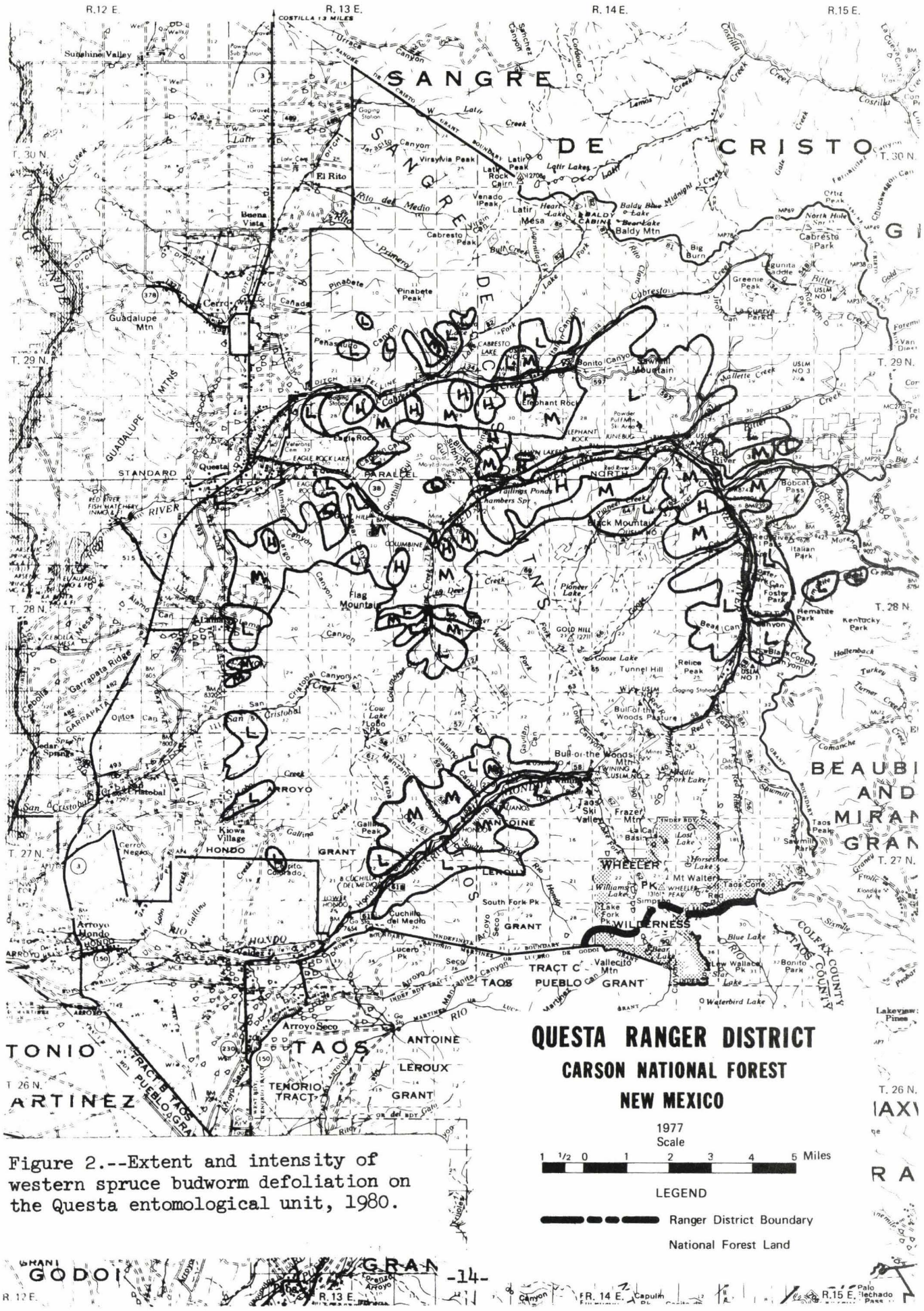
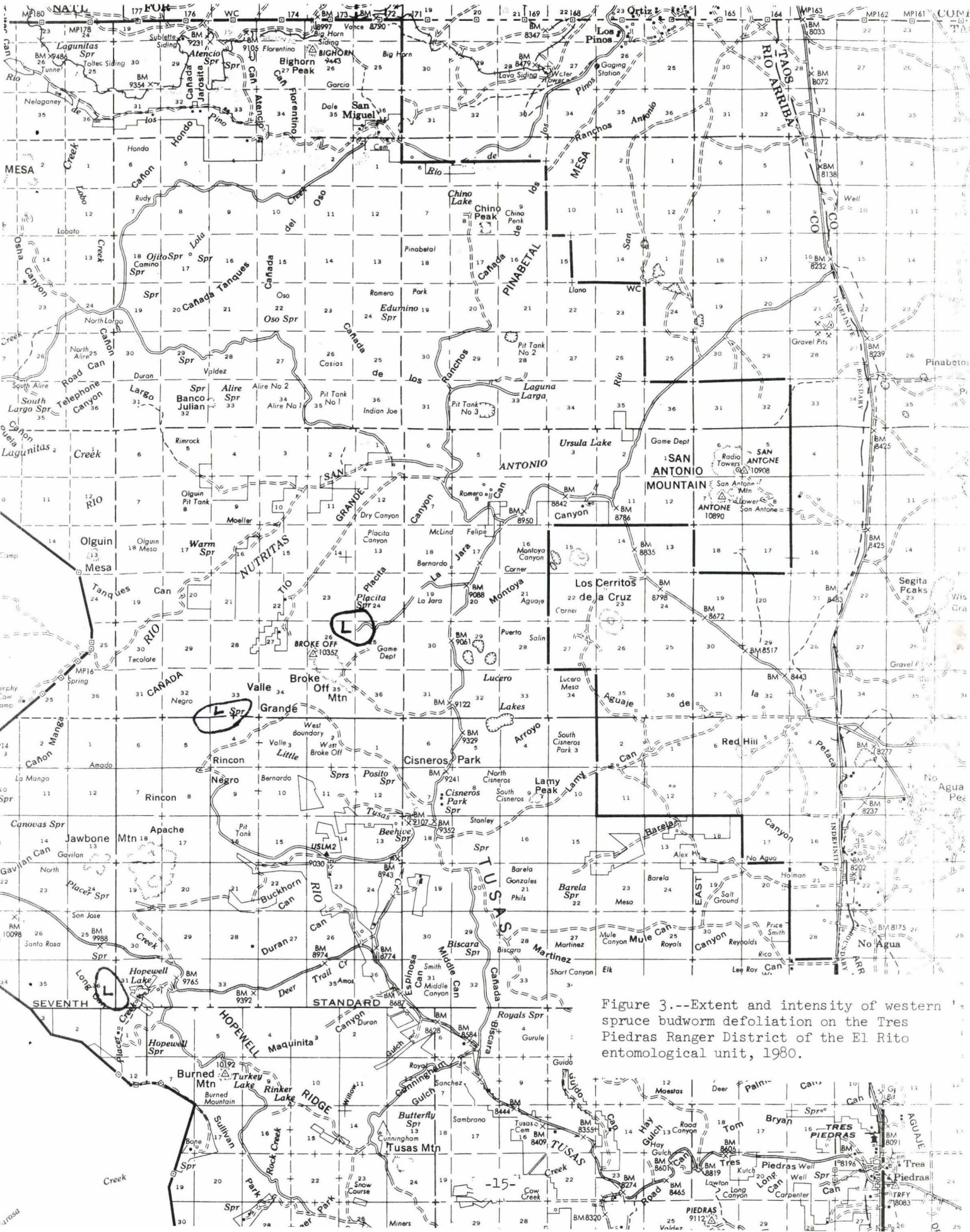


Figure 2.--Extent and intensity of western spruce budworm defoliation on the Questa entomological unit, 1980.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Rio de los Pinos
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Rio de la Manga
Rio de la Canada
Rio de la Negro
Rio de la Tecolote
Rio de la Spring
Rio de la Valle
Rio de la Grande
Rio de la Placita
Rio de la Montoya
Rio de la Corner
Rio de la Lucero
Rio de la Arroyo
Rio de la Lakes
Rio de la Boundary
Rio de la Gravel Pits
Rio de la Pinabetos
Rio de la Llano
Rio de la Pinabetal
Rio de la Chino Peak
Rio de la Chino Lake
Rio de la Ursula Lake
Rio de la Game Dept
Rio de la Radio Towers
Rio de la Lower San Antone
Rio de la Gaging Station
Rio de la Water Tower
Rio de la Lava Siding
Rio de la Big Horn
Rio de la Florentino
Rio de la Dale
Rio de la Garcia
Rio de la Romero
Rio de la Park
Rio de la Edumino
Rio de la Oso
Rio de la Canada
Rio de la Casias
Rio de la Pit Tank No 1
Rio de la Pit Tank No 2
Rio de la Pit Tank No 3
Rio de la Laguna Larga
Rio de la Indian Joe
Rio de la Alire
Rio de la Alire No 1
Rio de la Alire No 2
Rio de la Banco
Rio de la Julian
Rio de la Valdez
Rio de la Duran
Rio de la Rimrock
Rio de la Olguin
Rio de la Olguin Pit Tank
Rio de la Olguin Mesa
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Rio de la Felipe
Rio de la Bernardo
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Rio de la Puerto
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Rio de la Petaca
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Rio de la North Cisneros
Rio de la South Cisneros
Rio de la Lamy Peak
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Rio de la Canyon
Rio de la No Agua
Rio de la Holman
Rio de la Alex Hill
Rio de la Salt Ground
Rio de la Price Smith
Rio de la Reynolds
Rio de la Rico
Rio de la Mule Canyon
Rio de la Royals
Rio de la Martinez
Rio de la Biscara
Rio de la Short Canyon
Rio de la Elk
Rio de la Lee Roy Can
Rio de la Middle Canyon
Rio de la Smith
Rio de la Espinosa
Rio de la Amos
Rio de la Deer
Rio de la Trail Cr
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Rio de la Long
Rio de la Placer
Rio de la Hopewell Spr
Rio de la Maquinita
Rio de la Duran
Rio de la Royal Spr
Rio de la Gurule
Rio de la Guido
Rio de la Cunningham
Rio de la Sanchez
Rio de la Gulch
Rio de la Willow
Rio de la Rinker Lake
Rio de la Turkey Lake
Rio de la Burned Mountain
Rio de la Sullivan
Rio de la Bone
Rio de la Rock Creek
Rio de la Park
Rio de la Snow Course
Rio de la Miners
Rio de la Butterfly Spr
Rio de la Sambrano
Rio de la Tusas Cem
Rio de la Tusas Mtn
Rio de la Cow Creek
Rio de la Lawton
Rio de la Long Canyon
Rio de la Carpenter
Rio de la Piedras Well
Rio de la Tres Piedras
Rio de la Hay Gulch
Rio de la Road Canyon
Rio de la Tom Bryan
Rio de la Moestas
Rio de la Deer Palm
Rio de la Aguaje
Rio de la Tusas
Rio de la Buckhorn
Rio de la Jawbone Mtn
Rio de la Apache
Rio de la Pit Tank
Rio de la Beehive Spr
Rio de la Stanley
Rio de la Tusas
Rio de la Posito Spr
Rio de la Sprs
Rio de la Bernardo
Rio de la Negro
Rio de la Rincon
Rio de la Amado
Rio de la Little
Rio de la West Broke Off
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Rio de la Broke Off
Rio de la Tecolote
Rio de la Placita Spr
Rio de la La Jara
Rio de la Corner
Rio de la Montoya
Rio de la Aguaje
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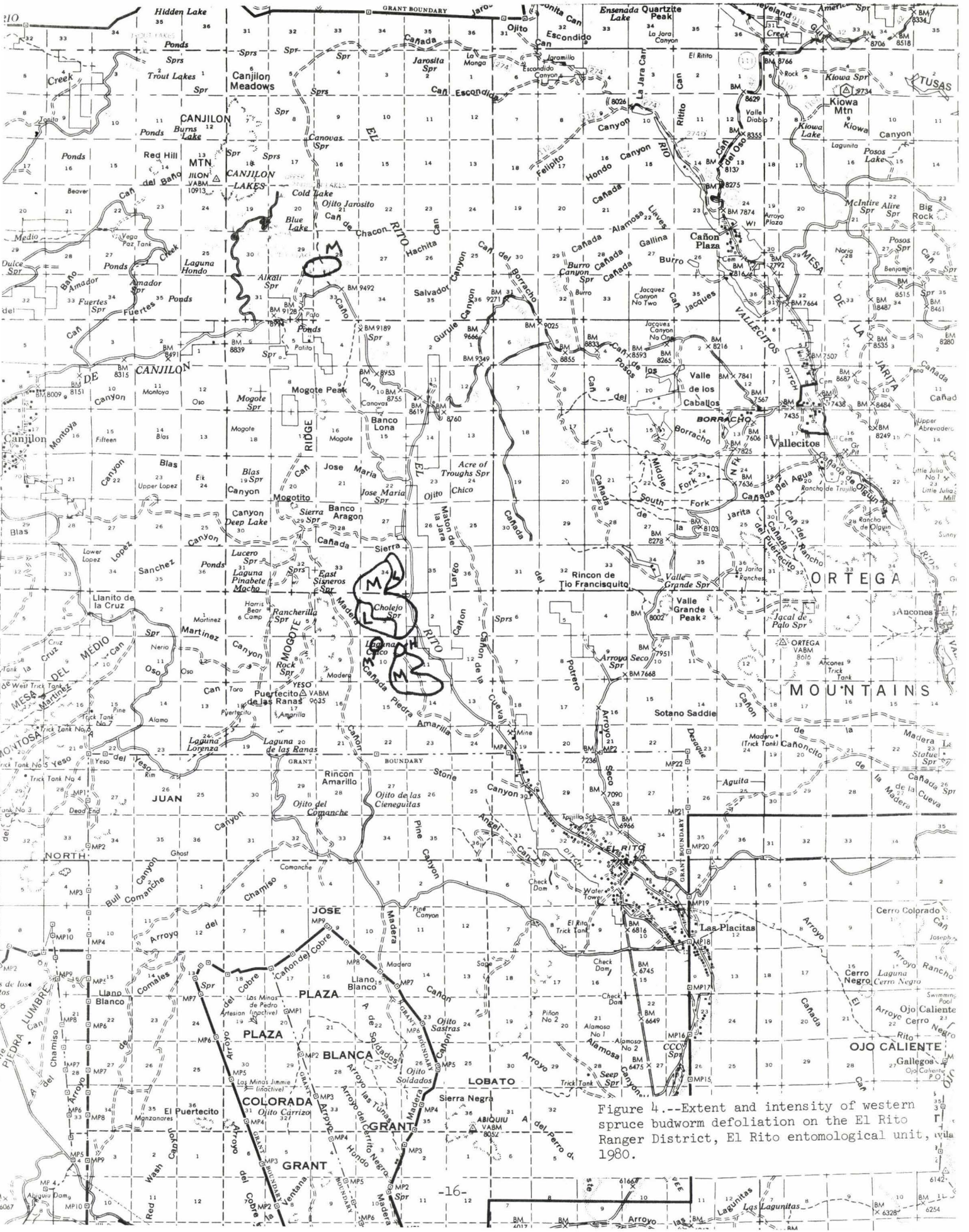
Rio de la Boundary
Rio de la Gravel Pits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BLANCA
COLORADA
GRANT
LOBATO
OJO CALIENTE
Las Placitas
Vallecitos
Valle de los Caballos
Cañon Plaza
Rincon de Tio Francisquito
Valle Grande Peak
Sotano Saddle
Mogote Peak
Banco Lona
Banco Aragon
Puertecito de las Ranas
Laguna de las Ranas
Rincon Amarillo
Ojito de las Cieneguitas
Ojito del Comanche
Ojito Soidados
Sierra Negra
El Puertecito
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Las Minas de Pedro Artesian (inactive)
Ojito Carrizo
Ojito Sastras
Cholejo Spr
Mogote Rock Spr
Sierra Spr
East Sisneros Spr
Lucero Spr
Laguna Pinabete
Laguna Lorenza
Laguna Hondo
Laguna Cerco
Rancherilla Spr
Acre of Troughs Spr
Jose Maria Spr
Alkali Spr
Cold Lake
Blue Lake
Ojito Jarosito
Canovas Spr
Trout Lakes
Canjilon Meadows
Canjilon Lakes
Red Hill
Burns Lake
Hidden Lake
Ponds
Creek
Canyon
Cañada
Arroyo
Rito
Mesa
Ridge
Ditch
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Kiowa Lake
Posos Lake
Big Rock
Cerro Colorado
Cerro Negro
Ojo Caliente
Gallegos
Las Lagunitas
Llano Blanco
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Cañada de la Cueva
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Cañon del Cobre
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Cañon de los Posos
Cañon del Borracho
Cañon del Puertecito
Cañon Largo
Cañon Ventana
Cañon Hondo
Cañon Stone
Cañon Pine
Cañon Chamiso
Cañon Bull Comanche
Cañon Ghost
Cañon Toro
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Cañon Mogote
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Cañon Blas
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Cañon Dead End
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Cañon Pine
Cañon Puertecito
Cañon Amarilla
Cañon Aguita
Cañon Desague
Cañon Potrero
Cañon Arroyo Seco
Cañon Mine
Cañon Trujillo Sch
Cañon Angel
Cañon Check Dam
Cañon Water Tower
Cañon Piñon No 2
Cañon Alamosa No 1
Cañon Alamosa No 2
Cañon Seep Spr
Cañon Trick Tank
Cañon Sage
Cañon Llano Blanco
Cañon Comanche
Cañon Chamiso
Cañon Pine Canyon
Cañon Arroyo Seco
Cañon Arroyo Las Tunas
Cañon Arroyo del Cerrito Negro
Cañon Arroyo del Cobre
Cañon Arroyo del Perro
Cañon Arroyo de Soidados
Cañon Arroyo Ventana
Cañon Arroyo Hondo
Cañon Arroyo Rancho
Cañon Arroyo Cerro Negro
Cañon Arroyo Caliente
Cañon Arroyo Gallegos
Cañon Arroyo Las Lagunitas
Cañon Arroyo Abiquiu
Cañon Arroyo Abiquiu Dam
Cañon Arroyo Wash
Cañon Arroyo Red
Cañon Arroyo Piedra Lumbre
Cañon Arroyo Chamiso
Cañon Arroyo Comanche
Cañon Arroyo Bull Comanche
Cañon Arroyo Ghost
Cañon Arroyo Toro
Cañon Arroyo Sierra
Cañon Arroyo Madera
Cañon Arroyo Lopez
Cañon Arroyo Sanchez
Cañon Arroyo Martinez
Cañon Arroyo Montoya
Cañon Arroyo Canjilon
Cañon Arroyo Dulce
Cañon Arroyo Fuertes
Cañon Arroyo Amador
Cañon Arroyo Medio
Cañon Arroyo Mogote
Cañon Arroyo Jose Maria
Cañon Arroyo Blas
Cañon Arroyo Deep Lake
Cañon Arroyo Lower Lopez
Cañon Arroyo Upper Lopez
Cañon Arroyo Oso
Cañon Arroyo Nerio
Cañon Arroyo Cruz
Cañon Arroyo Pinabete
Cañon Arroyo Alamo
Cañon Arroyo Trick Tank No 7
Cañon Arroyo Trick Tank No 6
Cañon Arroyo Trick Tank No 5
Cañon Arroyo Trick Tank No 4
Cañon Arroyo Dead End
Cañon Arroyo Yeso
Cañon Arroyo Pine
Cañon Arroyo Puertecito
Cañon Arroyo Amarilla
Cañon Arroyo Aguita
Cañon Arroyo Desague
Cañon Arroyo Potrero
Cañon Arroyo Seco
Cañon Arroyo Mine
Cañon Arroyo Trujillo Sch
Cañon Arroyo Angel
Cañon Arroyo Check Dam
Cañon Arroyo Water Tower
Cañon Arroyo Piñon No 2
Cañon Arroyo Alamosa No 1
Cañon Arroyo Alamosa No 2
Cañon Arroyo Seep Spr
Cañon Arroyo Trick Tank
Cañon Arroyo Sage
Cañon Arroyo Llano Blanco
Cañon Arroyo Comanche
Cañon Arroyo Chamiso